Claims

1. A temperature sensor comprising:

a cylindrical metal tube extending in an axial direction and having a front end side blocked;

a thermal sensing element held in an inside of said metal tube and including a thermal sensing portion with electrical characteristic varying according to a temperature, and a pair of electrode wires provided in said thermal sensing portion and extending toward a rear end side of said metal tube; and

a sheath member held in an inside of said metal tube and including a sheath pipe in which a pair of metal cores connected to said pair of electrode wires of said thermal sensing element are held while electrically insulated, wherein:

said metal tube has a small-diameter portion located on a front end side and entirely having an inner diameter smaller than an outer diameter of said sheath member, and a large-diameter portion located on a rear end side of said small-diameter portion and having a diameter larger than an outer diameter of said small-diameter portion; and

said thermal sensing portion is held in said small-diameter portion and an electrically insulating member is filled at least in between a front end of said thermal sensing portion and a front end of an inner wall of said metal tube.

2. The temperature sensor as claimed in claim 1,

wherein a longest distance H between a front end of said thermal sensing portion and a front end of an inner wall of said metal tube is not larger than 2.0 mm.

3. The temperature sensor as claimed in claim 1 or 2, wherein:

a shortest distance L between said thermal sensing portion and said metal tube satisfies $0 \leq L \leq 0.3$ mm; and

an outer diameter of said small-diameter portion is not larger than 3.5 mm.

4. The temperature sensor as claimed in any one of claims 1 to 3, wherein an average filling rate of said electrically insulating member is not lower than 75 %.

5. The temperature sensor as claimed in any one of claims 1 to 4, wherein a heat conductivity of said electrically insulating member is not lower than 1.2 W/m·K.

6. The temperature sensor as claimed in any one of claim 1 to 5, wherein said electrically insulating member is a material containing alumina as a main component.

7. The temperature sensor as claimed in any one of claims 1 to 6, wherein said electrically insulating member is

filled at least in a whole of a space ranging from a front end of said metal tube to a rear end of said thermal sensing portion.

8. The temperature sensor as claimed in any one of claims 1 to 6, wherein said electrically insulating member is filled at least in a whole of said small-diameter portion.

9. The temperature sensor as claimed in any one of claims 1 to 6, wherein a rear end of said electrically insulating member is located on a front end side viewed from a front end of said sheath pipe.

10. The temperature sensor as claimed in any one of claims 7 to 9, wherein an adiabatic member is provided between a rear end of said electrically insulating member and a front end of said sheath pipe.

11. The temperature sensor as claimed in any one of claims 1 to 10, wherein all regions of said pair of electrode wires located on a rear end side viewed from a rear end of said thermal sensing portion are disposed in said large-diameter portion.